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DISCUSSIONS

RELATIVE COST OF PUBLIC AND PRIVATE USES OF WATER¹

LEONARD METCALF: The author's method of distribution of water works expenditures between the domestic and fire protection services has been used in some cases. This method is to subtract from the total reproduction cost of the existing plant the reproduction cost of a plant designed for domestic service alone in order to ascertain the value of the plant used for fire protection. On strictly equitable grounds it is probably fairer to figure the relative costs on the basis of the relative maximum water demand and the water demand for the fire service alone. By Mr. Story's method the benefit of any doubt is given to the city because relatively less is charged to the fire service than to the domestic service. This may be justified on the ground that the general public does benefit by the fire service, as in a congested value district, on account of the greater protection in case of a conflagration. But the method is not so equitable under the ordinary demands for water.

The case of the water supplied to the Industrial School brings home in concrete fashion the danger of paying public bills by giving water service free. Such payments were often made before the public service commission frowned on the practice. The difficulty is that what the future will bring cannot be forecast and there have been many cases where, in the final analysis, under conditions that actually developed, more than an equitable sum has been paid under such an agreement. There have been a number of cases in the more arid regions on the Pacific Coast where the total cost of the water furnished under such a method of purchase has been very high.

WALTER E. MILLER: The writer has always maintained with regard to Mr. Story's method of dividing the investment charges between public and private service, that there was fully as much reason for subtracting the cost of a plant for public service from

¹ Discussion of paper by Stephen B. Story on "The Revenue Chargeable to Public Uses of Water in the City of Rochester, N. Y.;" JOURNAL, November, 1920, page 869.

that of the existing plant and charging whatever balance might remain to the private service, sometimes called the domestic and industrial service. This opinion is based on the many water works possessing a domestic and industrial service of such a character that the plants were apparently built for fire protection primarily. Many of these little works, particularly in the Central States, started off with a very few consumers along the original 8 or 10 miles of pipe, indicating that the primary purpose of the plant was fire protection. In such cases there is more reason in charging public service with so much of the existing investment as would be needed to care for it with a separate plant, with the balance of the investment charged to domestic and industrial service.

The best method is to divide the cost of the existing plant between public and private service on the basis of the relative costs of separate plants for each.

ELECTROLYSIS²

GELLERT ALLEMAN: The author cannot recommend any single method of installation as a cure-all for electrolysis, any more than a physician can relieve all diseases by the application of one particular remedy. Every pipe system must be considered individually. There are a number of methods employed in attempts to mitigate the damage done by stray currents. It is stated by advocates of the so-called three-wire system that little damage will result from electrolysis by this means of distribution. These statements are contradicted by facts. In a number of places that the author knows of, the three-wire system is responsible for very serious electrolytic corrosion. Theoretically, this system of distribution is interesting; but, in practice, the adjustments have not been made perfect and the desired electrolytic equilibrium has not been established.

The drainage of pipes by means of copper cables is an important attempt towards mitigating the damage by electrolysis. If a sufficient number of locations are intelligently selected, and a sufficient number of copper cables, having the desired capacity, are

² In the discussion of Dr. Gellert Alleman's paper on "Some Aspects of Electrolysis" (JOURNAL, November, 1920, page 882), a number of comments were made which it has as yet been impracticable to obtain in revised form from those making them. The author has, however, contributed the above discussion of the practical points referred to on the floor of the Montreal convention, following the reading of the paper on June 24, 1920.

installed, nearly all of the current is returned over these metallic conductors. The current causes no damage when taken off in this manner. It must be remembered, however, that even with the installation of copper cables, small amounts of current may leak from pipes through the soil at points distant from these cable connections, and electrolysis will result under these circumstances.

Insulated pipe joints should not be installed in localities where electrolytic corrosion may take place. When such installations are made and such a piping system is in a path between some other sub-surface structure, for instance, a large water main, the current, in passing through the earth, will get on an insulated section of pipe and is then bound to leave it for the metal having the greater conductivity. In so doing it will corrode the insulated pipe. Such destruction will take place much more rapidly than if the insulated pipe were part of a continuous conductor. In the case of a pipe line made up of insulated sections the current is apt to leave the pipe, through the earth, get on to the next length of pipe, leave it again through the earth, and again enter and leave the pipe many times. Since one ampere, flowing for one year, will dissolve or corrode 20 pounds of iron provided it leaves the pipe but once, when this amount of current leaves the pipe twice it will dissolve 40 pounds of iron; and if it enters and leaves the pipe ten times it will dissolve or corrode 200 pounds of iron.

Recently the author made extensive electrolytic tests in a large city. In order to determine the "drop" on various sections of track, connections were made, at the two track ends, through telephone wires and recording instruments were employed to indicate the differences of potential between the points mentioned. In one case, connections being made 3 miles apart, the track "drop" was 90 volts. An examination of this track showed that workmen were making repairs and numbers of rail bonds were broken. After these rails were properly bonded the same track "drop" was again determined and it was found to be 18 volts. The efficient bonding of the rail is, of course, one of the best safeguards we have. Another suggestion in connection with rail bonding is this: Every time a new power station is put in service the electrical conditions are changed. New power stations and the installation of new tracks should always be accompanied by proper electrolytic protection of the pipe system.

In general, those systems should be employed which will effectively take the current off the pipe through metallic circuits, so that the

current does not leave the pipes through the earth and thus dissolve or corrode the iron or the lead. This can be brought about by proper attention to the electrical continuity of the track by means of the installation of the proper rail-bonds, by a proper regard for the location of feeding stations, and by the judicious use of return cables.

Every pipe system should be considered individually. Conditions may arise within one system which may demand a certain specific method in order to insure protection against electrolytic corrosion. Different conditions may exist in some other pipe system which may be more efficiently protected by the installation of a different mitigating system, or by a combination of a number of systems.

Frequent electrical tests should be made on pipe systems in order to determine whether or not they are receiving proper protection. These examinations should be made at least once a year. If tracks are rearranged, or if new power plants are installed, or the distribution system changed, or additional drainage supplied, electrolytic measurements should be made immediately after such modifications are made.